

Understanding the Effects of Maltreatment on Early Brain Development



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"Our brains are sculpted by our early experiences. Maltreatment is a chisel that shapes a brain to contend with strife, but at the cost of deep, enduring wounds."

--Teicher, 2000, p.67

In recent years, there has been a surge of research into early brain development. As recently as the 1980s, many professionals thought that by the time babies are born, the structure of their brains was already genetically determined. The role of experience on the developing brain structure was under-appreciated, as was the active role of babies in their own brain development through interaction with their environment (Shore, 1997). While much of the research examining brain functioning has been done with animals, new technologies are enabling more non-invasive research to be done with humans. Although there is still much to learn, we now know much more about the brain's development and functioning.

One area that has been receiving increasing research attention involves the effects of abuse and neglect on the developing brain during infancy and early childhood. Much of this research is providing biological explanations for what practitioners have been describing in psychological, emotional, and behavioral terms. We are beginning to see the scientific "evidence" of altered brain functioning as a result of

early abuse and neglect. This emerging body of knowledge has many implications for the prevention and treatment of child abuse and neglect.

HOW THE BRAIN DEVELOPS

What we have learned about the process of brain development has helped us understand more about the influence of genetics and environment on our total development—the "nature versus nurture" debate. It appears that genetics predispose us to develop in certain ways. But our interactions with our environment have a significant impact on how our predispositions will be expressed; these interactions organize our brain's development and, therefore, shape the person we become (Shore, 1997).

Forming the Structure

The raw material of the brain is the nerve cell, called the *neuron*. When babies are born, they have almost all of the neurons they will ever have, more than 100 billion of them. Although there is research that indicates some neurons are developed after birth and well into adulthood (Shonkoff & Phillips, 2000), the neurons babies have at birth are primarily what they have to work with as they develop into children, adolescents, and adults.

During fetal development, the neurons that are created migrate to form the various parts of the brain.

While the basic structure is intact at birth, much of the brain's growth occurs during the first few years after birth. This process of growth, or development, occurs sequentially from the "bottom up" (Perry, Pollard, Blakely, Baker & Vigilante, 1995; Perry 2000a).

The first areas of the brain to fully develop are the brainstem and midbrain; they govern the bodily functions necessary for life, called the autonomic functions. The last regions of the brain to fully develop are the limbic system, involved in regulating emotions, and the cortex, involved in abstract thought. (See Exhibit 1.) Each region manages its assigned functions through complex processes, often using chemical

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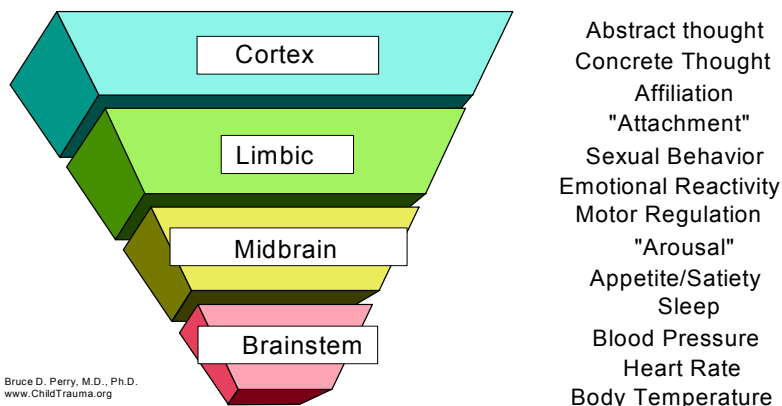
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Exhibit 1



messengers (such as neurotransmitters and hormones) to help transmit information to other parts of the brain and body (Perry, Pollard, Blakely, Baker & Vigilante, 1995; Perry 2000a).

As the brain develops, it grows larger and more dense. By the age of 3, a baby's brain has reached almost 90 percent of its adult size (Perry, 2000c). The growth in

each region of the brain largely depends on receiving stimulation, which spurs activity in that region. This stimulation provides the foundation for learning.

Organizing the Structure

Brain development, or learning, is actually the process of creating, strengthening, and discarding connections among the neurons; these connections are called *synapses*. Synapses organize the brain by forming neuronal pathways that connect the parts of the brain governing everything we do—from breathing and sleeping to thinking and feeling. This is the essence of post-natal development, because at birth, very few synapses have been formed. The synapses present at birth are primarily those that govern our bodily functions such as heart rate, breathing, eating, and sleeping. Almost all other functions are developed as babies grow up into children and adults (Shore, 1997).

The development of synapses occurs at an astounding rate during children's early years. By the time children are 3, their brains have approximately 1,000 trillion synapses, many more than they will ever need. Some of these synapses are strengthened and remain intact, but many are discarded. By the time children

have reached adolescence, about half of their synapses have been discarded, leaving about 500 trillion, the number they will have for most of the rest of their lives (Shore, 1997).

Plasticity—The Influence of Environment

"Plasticity is a double-edged sword that leads to both adaptation and vulnerability."

--Shonkoff & Phillips, 2000, p. 94

Researchers use the term *plasticity* to describe the way the brain creates, strengthens, and discards synapses and neuronal pathways in response to the environment (Ounce of Prevention Fund, 1996). The brain's "plasticity" is the reason that environment plays a vital role in brain development.

The early over-production of synapses appears to be the result of evolution that has led our brains to expect certain experiences (Greenough, Black & Wallace, 1987). Our brains prepare us for these experiences by forming the pathways needed to respond to those experiences. For example, our brains are "wired" to respond to the sound of speech; this is how we learn to talk. But these early synapses are weak; we must be repeatedly exposed to the expected experiences within a certain time period to activate and strengthen them. If this does not happen, the pathways developed in anticipation of those experiences may be discarded, and the development of the related functions will not occur as expected. This is often referred to as the "use it or lose it" principle (Greenough, Black & Wallace, 1987).

In addition to strengthening or discarding existing synapses, researchers theorize that some synapses may be newly developed in response to unique

Prenatal Exposure to Alcohol and Other Drugs

Exposure to alcohol and other drugs in utero can disrupt and significantly impair the way a baby's brain is formed (Shore, 1997).

Studies have shown that exposure to alcohol or other drugs, especially early in pregnancy, can alter the development of the cortex, reduce the number of neurons that are created, and affect the way in which chemical messengers are used (Shore, 1997). Although not all children who are exposed develop neurobiological problems, many do. These problems include difficulties with attention, memory, problem-solving, and abstract thinking. Many children born with Fetal Alcohol Syndrome are mentally retarded (Shonkoff & Phillips, 2000).

environmental conditions (Greenough, Black & Wallace, 1987). It is through these processes of creating, strengthening, and discarding synapses that our brains adapt each of us to our unique environment.

The ability to adapt to our environment is a part of normal development. Children growing up in cold climates or rural farms or large sibling groups learn how to function in those environments. But regardless of the general environment, all children need stimulation and nurturance for healthy development. If these are lacking—if a child's caretakers are indifferent or hostile—the child's brain development may be impaired. Because the brain adapts to its environment, it will adapt to a negative environment just as readily as it will adapt to a positive environment.

Sensitive Periods

"It is now clear that what a child experiences in the first few years of life largely determines how his brain will develop and how he will interact with the world throughout his life."

--Ounce of Prevention Fund, 1996

Researchers believe that during these years there may be "sensitive periods" for development of certain capabilities (Greenough, Black & Wallace, 1987). Because synapses are being formed at such an intense pace during this time, the opportunities for learning are almost limitless. But as the process of pruning synapses starts to increase, especially after age 3, these opportunities begin to decrease (Shore, 1997). If certain synapses and neuronal pathways are not repeatedly activated, they may be discarded, and the capabilities they promised may be diminished. For example, all infants have the capacity, indeed the genetic predisposition, to form

strong attachments to their primary caregivers. But if a child's caregivers are unresponsive or threatening, and the attachment process is disrupted, the child's ability to form any healthy relationships during his or her life may be impaired (Perry, 2001a).

Although the first few years may be the "prime time" for learning, children and adults can learn later in life, but it is more difficult. This is especially true if a young child was deprived of certain stimulation, which resulted in the pruning of synapses and the loss of neuronal pathways. Helgeson (1997) offers the analogy of a country that has a dense network of branching streets; a traveler can go anywhere he wants, even

Malnutrition

Malnutrition, both before and during the first few years after birth, has been shown to result in stunted brain growth and slower passage of electrical signals in the brain (Pollitt & Gorman, 1994; Shonkoff & Phillips, 2000). These effects on the brain are linked to cognitive, social, and behavioral deficits with possible long-term consequences (Karr-Morse & Wiley, 1997).

For example, iron deficiency (the most common form of malnutrition in the United States) can result in cognitive and motor delays, anxiety, depression, social problems, and problems with attention (Shonkoff & Phillips, 2000). Protein deficiency can result in motor and cognitive delays and impulsive behavior (Pollitt & Gorman, 1994). The social and behavioral impairments may be more difficult to "repair" than the cognitive impairments, even if the nutritional problems are corrected (Karr-Morse & Wiley, 1997).

unfamiliar places, by following the roads. If there are few roads, the traveler can still go places, but he has to travel "cross-country" and break new ground. It is doable, but much harder. As children progress through each developmental stage, they will learn and master each step more easily if their brains have built an efficient network of pathways.

While research has shown that the brain is more malleable in the first few years than at any other time in life, researchers disagree on how flexible or rigid the sensitive periods are. But they do agree that the experiences of the first few years form the foundation for children's future functioning. "While experiences may alter and change the functioning of an adult, experience literally provides the organizing framework for an infant and child" (Perry, Pollard, Blakely, Baker & Vigilante, 1995).

Memories

The "organizing framework" for children's development is based on the creation of "memories." When repeated experiences strengthen a neuronal pathway, the pathway becomes "sensitized," and, at some point, it becomes a memory. Memories are an indelible impression of the world (Perry, 1999); they are the way in which the brain stores information for easy retrieval.

There are different types of memories, such as motor, cognitive, and emotional memories. Memories help us to navigate our world without having to really think about it (Perry, 1999). Children learn to put one foot in front of the other to walk. They learn words to express themselves. And they learn that a smile usually brings a smile in return. At some point, they no longer have to think much about these processes—their brains manage these experiences with

little effort because the memories that have been created allow for a smooth, efficient flow of information.

The creation of memories is part of our adaptation to our environment. Our brains attempt to understand the world around us and fashion our interactions with that world in a way that promotes our survival and, hopefully, our growth. But if the early environment is abusive or neglectful, our brains will create memories of these experiences that may adversely color our view of the world throughout our life.

EFFECTS OF MALTREATMENT ON BRAIN DEVELOPMENT

"Harry Chugani observes '... We can have individuals who, based on early experiences, are in effect "hard-wired" for negative behaviors.' Some neuroscientists consider this an overstatement; others find it too mild"

--Shore, 1997, p. 40

Babies' brains grow and develop as they interact with their environment and learn how to function within that environment. When babies' cries bring food or comfort, they are strengthening the neuronal pathways that help them learn how to get their needs met, both physically and emotionally. But babies who do not get responses to their cries, and babies whose cries are met with abuse, learn different lessons. The neuronal pathways that are developed and strengthened under negative conditions prepare children to cope in that negative environment, and their ability to respond to nurturing and kindness may be impaired (Shonkoff & Phillips, 2000).

Stress

Brief periods of moderate, predictable stress are not problematic; in fact, they prepare the child to cope with the general world. The body's survival actually depends upon the ability to mount a response to stress (Shonkoff & Phillips, 2000). But prolonged, severe, or unpredictable stress—including abuse and neglect—during a child's early years *is* problematic. The brain's development can literally be altered by these experiences, resulting in negative impacts on the child's physical, cognitive, emotional, and social growth.

Chronic stress sensitizes neural pathways and over-develops certain regions of the brain involved in anxiety and fear responses, and often results in the under-development of other neural pathways and other regions of the brain (Shore, 1997). Children who experience the stress of physical or sexual abuse will focus their brains' resources on survival and responding to threats in their environment. Children who experience the chronic stress of neglect—e.g., remaining hungry, cold, scared, or in pain—will also focus their brains' resources on survival. This chronic stimulation of the brain's fear response means that the regions of the brain involved in this response are frequently activated. When they are, other regions of the brain, such as those involved in complex thought, can not also be activated and are therefore not "available" to the child for learning (Shore, 1997).

Because the brain ultimately controls all bodily functions, experiences that alter brain development also alter our bodies' responses. Studies have shown that "... the overwhelming stress of maltreatment experiences in childhood is associated with alterations of biological stress

systems and with adverse influences on brain development" (DeBellis, et al., 1999). One example of the effects of early maltreatment on brain and body functions involves the chemical cortisol. Cortisol is a hormone that helps the body prepare to cope with stress through its effects on metabolism and the immune system (Hart, Gunnar & Cicchetti, 1995). Studies have shown that many infants and children who have been maltreated have abnormal secretions of cortisol, indicating that their bodies' responses to stress have been impaired (Hart, Gunnar & Cicchetti, 1995; Lott, 1998, citing Main, 1996). More research is needed to understand why this occurs and what effects this may have on the children's emotional and social development, but this information provides some evidence of altered brain activity in maltreated children.

A key issue in understanding altered brain development in children who have been maltreated is that the way in which their brains develop is often a very adaptive response to their negative environment, but it is maladaptive in other environments (Hart, Gunnar & Cicchetti, 1996). If a child lives in a threatening, chaotic world, his brain will be hyper-alert for danger; his survival may depend on it. But if this environment persists, and the child's brain is focused on developing and strengthening its strategies for survival, other strategies may not develop as fully. If a child lives in a world that ignores him, if he is not provided with appropriate stimulation for growth, his brain will focus on survival from day to day and may not fully develop healthy cognitive and social skills (Ounce of Prevention Fund, 1996, citing Lieberman & Zeanah, 1995). The result may be a child who has great difficulty

functioning when presented with a world of kindness, nurturing, and stimulation. It is an unfamiliar world to him; his brain has not developed the pathways and the memories to adapt to this new world.

Persistent Fear Response

Fear is necessary to our basic survival. We must be able to detect threats and respond. Indeed, the brain is uniquely designed to sense, process, and store threatening information and to mobilize the body in response to threats. All parts of the brain and body are used in this response. “This total neurobiological participation in the threat response is important in understanding how a traumatic experience can impact and alter functioning in such a pervasive fashion” (Perry, 1999, p.3).

Chronic stress or repeated traumas can result in a number of biological reactions. Neurochemical systems are affected which can cause a cascade of changes in attention, impulse control, sleep, and fine motor control (Perry, 2000a; 2000c). Chronic activation of certain parts of the brain involved in the fear response (such as the hypothalamic-pituitary-adrenal [HPA] axis) can “wear out” other parts of the brain such as the hippocampus, which is involved in cognition and memory (Perry, 2000c). Early experiences of trauma can also interfere with the development of the subcortical and limbic systems which can result in extreme anxiety, depression, and difficulty forming attachments to other people (Shore, 1997). And chronic activation of the neural pathways involved in the fear response can create permanent “memories” which shape the child's perception of and response to his environment. While this adaptation may be necessary for survival in a hostile world, it can

become a way of life that is difficult to change, even if the environment improves.

Hyper-arousal

When a child is exposed to chronic, traumatic stress, his brain sensitizes the pathways for the fear response and literally creates memories such that his fear response becomes almost automatic; he doesn't really think about it. This is called a state of “hyper-arousal.” His brain has adapted to a world that is unpredictable and dangerous; it is hyper-vigilant, focused on non-verbal cues that may be threatening (Perry, 1996). The regions of the brain involved in the hyper-arousal response are always “on,” and because of this, the child may frequently experience hyperactivity, anxiety, impulsivity, and sleep problems (Perry, Pollard, Blakely, Baker & Vigilante, 1995). Hyper-arousal is most common in older children and in males (Perry, Pollard, Blakely, Baker & Vigilante, 1995).

In the state of hyper-arousal, similar to Post Traumatic Stress Disorder (PTSD), the brain's alarm system becomes particularly sensitive to “threatening” environmental cues, and the child may respond anxiously or aggressively. The regions of the brain involved in the hyper-arousal response become re-activated when the child is exposed to a reminder of the earlier trauma (such as thinking or dreaming about it), to perceived threats (which may not seem threatening to others), and sometimes to generalized reminders (signals) (Perry, Pollard, Blakely, Baker & Vigilante, 1995). Perry (1997) presents an example of an 8-year-old boy who became extremely agitated—sobbing and hysterical—when the staff at his group home refused to cut up his hot dog before he ate it. The child had been sexually abused by his

father and other men. Foods such as hot dogs, bananas, and popsicles evoked his brain's fear response, and until the “signal” was removed or altered, his brain experienced it as a threat. Another example is that of a child who had committed an impulsive, violent act and explained it by saying “I could tell he was going to jump me—he looked me in the eyes” (Perry, 1997, p. 6). In his mind, his brain, the simple act of looking him in the eye was perceived as a threat that required a defensive response.

Dissociative and Hyper-arousal Responses

Dr. Bruce Perry, former head of the Child Trauma Academy at Baylor College of Medicine in Houston, Texas, offers this example of dissociative and hyper-arousal responses in the same child for different events.

“T is a twelve year old girl. From birth until age five she lived in a household characterized by domestic violence. During this time, she was noted to be quiet, compliant, “tuned out,” daydreamed and generally “a good little girl.” She reports little memory of the fighting but her mother describes finding her in her bed, rocking, with covers over her head after some of the fights in the home. At age 12, her mother remarried but unfortunately, episodes of domestic violence resumed in this household. This time, however, T was loud, combative, angry and would run away from the home each time these events took place. She was noted to have “attention” problems at school that turned out to be hypervigilance. Rather than “tuning out” and withdrawing into a dissociative shell, this child was sensitized to fighting and had dramatic and pronounced hyperarousal during conflict.”

--Perry, 2000b, p.8

Not only may children in a state of hyper-arousal react anxiously or aggressively to perceived threats, they may actually provoke threatening behavior from others in order to have some control over it. Predictability of threat is important (Perry, 1997). Children who have been victims of unpredictable physical or sexual abuse learn (consciously or unconsciously) that if abuse is going to happen, it is better to control when it happens. They may engage in aggressive, provocative behavior to elicit a predictable response (Perry, 1997).

For example, a girl who has suffered repeated sexual abuse from her father may attempt to seduce a male teacher. She may believe that men will invariably try to have sex with her, so she tries to control when and with whom.

Dissociation

While hyper-arousal is more common in older children and males, dissociation is more common in younger children and in females—children who often feel or are immobile or powerless (Perry, Pollard, Blakely, Baker & Vigilante, 1995). Dissociation is characterized by first attempting to bring caretakers to help, and if this is unsuccessful, becoming motionless (freezing) and compliant and eventually dissociating; this is often called the “surrender” response (Perry, Pollard, Blakely, Baker & Vigilante, 1995). People describe children in a dissociative state as numb, non-reactive, or “acting like they aren't there.”

Just as children in a state of hyper-arousal have sensitized neural pathways controlling their response to a threatening environment, children in a state of dissociation have sensitized neural pathways that elicit a different response. A child in a dissociative state, when presented with a threat, may “freeze,” both physically and cognitively (Perry, Pollard, Blakely, Baker & Vigilante, 1995). When an adult asks or tells them to do something, they don't respond. If the adult becomes angry and more threatening, the child becomes even more anxious and moves further into full dissociation (Perry, Pollard, Blakely, Baker & Vigilante, 1995).

Disrupted Attachment Process

At the foundation of much of our development is the concept of “attachment” which refers to the

emotional relationships we have with other people. One of the first priorities of an infant is to form an attachment to his primary caregiver (Kraemer, 1992). This relationship not only provides the foundation for future emotional relationships, it also provides the base for other learning, because babies and children learn best when they feel safe, calm, protected, and nurtured by their caregivers. If the attachment process is disrupted, as can occur with abusive and neglectful caretakers, the child's brain will be more focused on meeting his day-to-day needs for survival rather than building the foundation for future growth.

Much of a child's emotional development is rooted in his relationships with his early primary caregivers. For example, it appears that aggressive, submissive, and frustration behaviors may be genetically encoded (Kraemer, 1992). If relationships with the caregivers are positive, the child's cognitive structures learn to regulate these emotions and behaviors. If the relationships are negative or weak, the lower-brain responses become dominant and the cognitive regulating structures do not develop to their full capacity—the young child may not fully develop the cognitive ability to control his emotions, nor develop an awareness of others' emotions (Kraemer, 1992).

One example of a potential effect of poor early attachments is impaired “social cognition” (Kraemer, 1992). Social cognition involves an awareness of oneself in relation to others and an awareness of the emotions of others. If these abilities are poorly developed, many types of social interactions may be experienced as stressful—unfamiliar, strange situations that are difficult for the child to incorporate because he

does not have a strong internal representation (memory) of what is happening and how to respond (Kraemer, 1992). Children who have been abused and neglected often lack empathy and truly do not understand what others feel like when they do something hurtful.

Neglect—Lack of Stimulation

While chronic abuse or neglect can result in sensitized fear response patterns, neglect alone also can result in other problems. Although neglect often is thought of as a failure to meet a child's physical needs for food, shelter, and safety, neglect also can be a failure to meet a child's cognitive, emotional, or social needs. For children to master developmental tasks in these areas, they need opportunities, encouragement, and acknowledgement from their caregivers. If this stimulation is lacking during children's early years, the weak neuronal pathways that had been developed in expectation of these experiences may wither and die—the children may not achieve the usual developmental milestones.

For example, babies need to experience face-to-face baby talk and hear countless repetitions of sounds in order to build the brain circuitry that will enable them to start making sounds and eventually say words and form sentences (Helgeson, 1997). If babies are ignored, if their caregivers do not provide this type of intense verbal interaction, their language development may be delayed. If a child does not receive kindness as an infant, he may not know how to show kindness as an adult. If a child's cries for attention are ignored as a toddler, he may not know how to interact positively with others later. These capacities may not fully develop because the required neuronal pathways were

not activated enough to form the “memories” needed for future learning (Greenough, Black & Wallace, 1987).

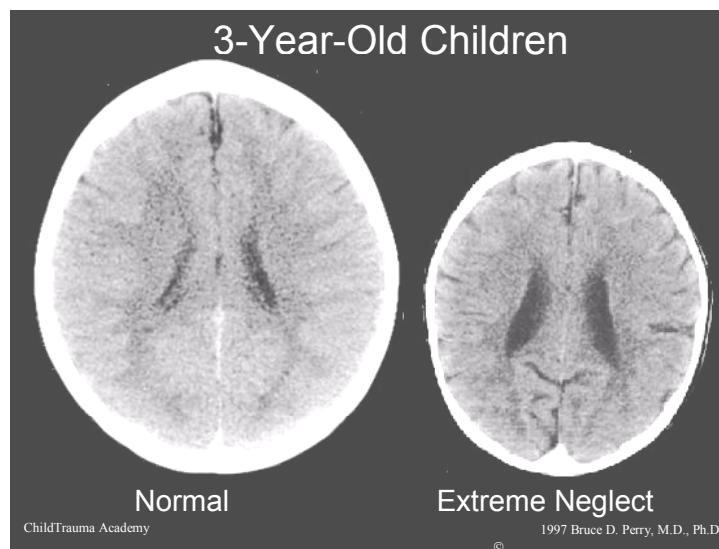
Global Neglect

The term “global neglect” is used when a child has experienced deprivations in more than one domain, i.e., language, touch, and social interaction (Perry & Pollard, 1997). Children who were adopted from Romanian orphanages in the early 1990s are often considered to be globally neglected; they had little contact with caregivers and little to no stimulation from their environment—little of anything required for healthy development. One study found that these children had significantly smaller brains than the norm, suggesting decreased brain growth. (Perry & Pollard, 1997). (See Exhibit 2.)

This type of severe, global neglect can have devastating consequences. The extreme lack of stimulation may result in fewer neuronal pathways available for learning; genetically normal children may be at a permanent intellectual disadvantage (Greenough, Black & Wallace, 1987). The lack of opportunity to form an attachment with a nurturing caregiver during infancy may mean that some of these children will always have difficulties forming meaningful relationships with others (Perry, 2001a). But these studies also found that time played a factor—children who were adopted as young infants have shown more recovery than children who were adopted as toddlers (Rutter, et al., 2000).

Pervasive and Long-term Effects

Maltreatment during infancy and



“These images illustrate the negative impact of neglect on the developing brain. In the CT scan on the left is an image from a healthy three year old with an average head size. The image on the right is from a three year old child suffering from severe sensory-deprivation neglect. This child's brain is significantly smaller than average and has abnormal development of cortex.” These images are from studies conducted by a team of researchers from the Child Trauma Academy (www.ChildTrauma.org) led by Bruce D. Perry, M.D., Ph.D.

early childhood has been shown to negatively affect early brain development and can have enduring repercussions into adolescence and adulthood. As mentioned earlier, the experiences of infancy and early childhood literally provide the organizing framework for the expression of children's intelligence, emotions, and personalities. When those experiences are primarily negative, children may develop emotional, behavioral, and learning problems that persist throughout their lifetime, especially in the absence of targeted interventions.

While some children seem unaffected or minimally affected by their traumatic experiences, in reality, it is often the adults around them who are misreading their cues. These children are communicating non-verbally with us, and we need to learn the language and educate others who work with children who have been maltreated about this language (Perry, 1999). Children do not just "get over it." As they attempt to cope, as their brains adapt to the negative environments, their true emotional, behavioral, cognitive, and social potential may be diminished (Perry, Pollard, Blakely, Baker & Vigilante, 1995).

Children who have experienced chronic abuse and neglect during their first few years may live in a persistent state of hyper-arousal or dissociation, anticipating threats around every corner, and their ability to benefit from social, emotional, and cognitive experiences may be impaired (Perry, 1996). The various regions of the brain can not grow without being activated, and certain regions can not be activated when others are. To learn and incorporate new information, whether it be a lesson in the classroom or a new social experience, the child's brain must be in a state of "attentive calm," a

state the traumatized child rarely achieves. It is not uncommon for teachers who work with traumatized children to observe that the children are really smart, but they do not learn easily; they are often diagnosed with learning disabilities (Perry, 1996). Children who have not been able to develop healthy attachments with their caregivers, and whose early emotional experiences have not laid the necessary groundwork for healthy emotional development, may have a limited capacity for empathy (Perry, 1997). The ability to feel remorse and empathy are built on experience. In the extreme, if a child feels no emotional attachment to any human being, he can not be expected to feel remorse for hurting or even killing someone. Perry (1997) offers the example of a 15-year-old boy who felt no remorse for having committed murder. The boy had been neglected and humiliated by his primary caretakers as a child. "He is literally emotionally retarded. The part of his brain which would have allowed him to feel connected to other human beings—empathy—simply did not develop" (Perry, 1997, p. 4).

The effects of abuse and neglect on the developing brain during children's first few years can result in various mental health problems. For example:

- Diminished growth in the left hemisphere may increase the risk for depression (Teicher, 2000).
- Irritability in the limbic system can set the stage for the emergence of panic disorder and post-traumatic stress disorder (PTSD) (Teicher, 2000).
- Smaller growth in the hippocampus and limbic abnormalities can increase the risk for dissociative disorders and memory impairments (Teicher, 2000).

- Impairment in the connection between the two brain hemispheres has been linked to symptoms of attention-deficit/hyperactivity disorder (ADHD) (Teicher, 2000).
- Severely neglected children who have been deprived of sensory stimulation—including touch, movement, and sound—may be at risk for Sensory Integration Disorder (SID) (Parent Network for the Post-Institutionalized Child, 1995).
- Children who have been raised in environments that totally disregarded their needs for comfort, stimulation, and affection may be at risk for Reactive Attachment Disorder (Parent Network for the Post-Institutionalized Child, 1995).

We are learning more about the serious, long-term consequences of abuse and neglect on brain development, and subsequent physical, cognitive, emotional, and social growth. What do we do with this information? What does it mean for biological parents, foster and adoptive parents, professionals, the child welfare system, and for society? How can we use this knowledge to improve our interventions with children who have been abused and neglected, and, most importantly, to prevent abuse and neglect from occurring? While these questions may be challenging, this growing body of knowledge compels us to work towards finding the answers.

IMPLICATIONS FOR PRACTICE AND POLICY

"The new developments in brain research show us what children need; our challenge is to ensure that every child receives it."
 --Ounce of Prevention Fund, 1996

The knowledge we have gained from research examining the effects of maltreatment on brain development can be helpful in many ways. With this information, we are better able to understand what is happening within the brains of children who have been abused and neglected. In fact, much of this research is providing further, solid evidence for what professionals and caregivers have been describing in behavioral, emotional, and psychological terms. We can use this information to improve our systems of care, and to strengthen our prevention efforts.

There has been some encouraging progress in States' recognition of early brain development research and how this information can be used to improve services. In a survey conducted by the Child Welfare League of America in 2000, 31 States reported that they had reviewed relevant research findings (CWLA, n.d.). Many also reported that they had engaged in efforts to increase awareness about early brain development, and that both legislative and policy changes had occurred to enhance prevention, early intervention, and healthy child development programs (CWLA, n.d.).

The Child Welfare System

While the goal of the child welfare system is to protect children, many child welfare interventions—such as investigation, appearance in court, removal from home, placement in a foster home, etc.—may actually reinforce the child's view that the world is unknown, uncontrollable, and frightening. These experiences can actually contribute to the traumatized child's "catalog" of fearful situations (Wolff & Brandt, 1998). In addition, many child welfare systems in the United States do not provide comprehensive assessments to all children in their care, and therefore the treatments

provided may not be the most effective—they may not accurately target each child's unique experience.

As much as possible, the child welfare system needs to address these deficits and reform practice to provide consistency, repetition, nurturance, predictability, and control (returned to the child) to diminish the fearful nature of the interventions (Wolff & Brandt, 1998). In addition, child welfare systems should provide comprehensive assessments for all children as soon as possible to examine their physical, cognitive, emotional, and social development (Committee on Early Childhood, Adoption and Dependent Care, 2000; Shonkoff & Phillips, 2000). Accomplishing these objectives will require the participation of all stakeholders including policymakers; family court judges; managers; child welfare workers; medical, mental health, and education professionals; kinship, foster, and adoptive parents; and the parents and children themselves. Every group must examine its contribution to the development of the children served by the child welfare system, and strive to provide that contribution in a manner that will promote healthy development for each child.

The Role of Professionals

One of the first tasks for professionals who work with children who have been maltreated is to educate themselves about the effects of maltreatment on early brain development, as well as interventions likely to be effective. For example, "talk" therapy must do more than talk if the child is in a persistent hyper-arousal state; the child's brain may well be unresponsive to verbal interactions (Lott, 1998; Perry, 1999). According to Dr. Schore, "What

will get through is tone of voice, demeanor, facial expressions and a sense of empathy that is rooted in the early psychobiological attunement between mother and infant" (Lott, 1998, p. 3).

Professionals who are knowledgeable about this issue need to educate others who work with and care for the children (Comfort, 1997; Committee on Early Childhood, Adoption and Dependent Care, 2000; Perry, 1996). Information can be provided to foster parents and other caregivers to help them understand the effects of maltreatment on children's brain development, how those early experiences may influence current behavior and functioning, and what can be done to help the children recover their lost potential. CPS workers, judges, and teachers also may not be knowledgeable about these issues; they can benefit from opportunities to understand the importance of their contributions to the child's environment. By working in a coordinated manner, professionals and caregivers can help to minimize unpredictable, unknown, and frightening experiences and assist the child's movement along a path of healthy development.

Human service professionals are increasingly receptive to new knowledge about human brain development (Shore, 1997). Professionals across disciplines are engaged in exciting new efforts to rethink the brain and apply the knowledge and ideas to support the healthy development and well-being of children (Shore, 1997). As these efforts begin to offer meaningful information, it must be translated into policies and practices for the front-line workers and caregivers in order to have the most impact on improving child well-being in child welfare systems.

The Role of Caregivers

Many children who have suffered abuse and neglect are removed from their homes by the child welfare system for their safety. These children may be temporarily cared for by extended family, foster parents, or group home staff, and some will be adopted. While many caregivers have an innate sense about how to raise children, familiarity with the effects of maltreatment on brain development and the possible manifestations of those effects are not likely to be “common knowledge.”

It is important for caregivers to have realistic expectations for the children in their care. Children who have been abused or neglected may not be functioning at their chronological age in terms of their physical, social, emotional, and cognitive skills. They may also be displaying unusual and/or difficult coping behaviors. For example, abused or neglected children may:

- Be unable to control their emotions and have frequent outbursts
- Be quiet and submissive
- Have difficulties learning in school
- Have difficulties getting along with siblings or classmates
- Have unusual eating or sleeping behaviors
- Attempt to provoke fights or solicit sexual experiences
- Be socially or emotionally inappropriate for their age
- Be unresponsive to affection.

“It is easy for foster parents to become confused, frustrated, and sometimes devastated from the lack of response and reciprocity to the love, affection, attention, and care they offer” (Comfort, 1997, p. 29). Even caregivers with the best of intentions can misunderstand a child's behavior, fashion their response based on that

misunderstanding, and then wonder why their response was not effective.

To be more effective in their roles, caregivers who serve abused and neglected children could benefit from training and support related to the effects of maltreatment on early brain development. Understanding some basic information about the neurobiology underlying many challenging behaviors may help caregivers shape their responses more effectively. But while a general understanding is helpful, foster parents and other caregivers need to know the history of their particular foster children's experiences in order to tailor their approaches (Comfort, 1997). They may need to develop some special skills to cope with the children's special needs.

In general, children who have been abused or neglected need nurturance, stability, predictability, understanding, and support (Committee on Early Childhood, Adoption and Dependent Care, 2000). They may need frequent, repeated experiences of these kinds to begin altering their view of the world from one that is uncaring or hostile to one that is caring and supportive. Until that view begins to take hold in the child's mind, the child may not be able to truly engage in a positive relationship. And the longer the child lived in the abusive or neglectful environment, the harder it will be to convince his brain that his world can change. But one thing we have learned from research is that environment does make a difference. Consistent nurturing from caregivers who receive training and support may offer the best hope for the children who need it most.

Intensive, Early Intervention

“The brain itself can be altered . . . with appropriately timed, intensive interventions”

--Shore, 1997, p. 36

Intensive, early interventions are key to minimizing the long-term effects of early trauma on children's brain development (Committee on Early Childhood, Adoption and Dependent Care, 2000). Two studies that have shown this impact include the following:

- Craig Ramey of the University of Alabama at Birmingham reported that vulnerable children who received services from 4 months to 5 years old showed better cognitive development than those receiving services from age 5 to age 8; the difference was even more pronounced at age 12 than at age 8 (Shore, 1997).
- Rutter, et al. (2000) studied the development of children adopted from Romanian orphanages. When each child was 6 years old, the researchers assessed what proportion of the adopted children were functioning “normally.” They found that 69 percent of the children adopted before the age of 6 months were functioning normally, 43 percent of the children adopted between the ages of 7 months and 2 years, and 22 percent of the children adopted between the ages of 2 years and 3½ years.

Indeed, many studies have shown the effectiveness of early intervention, but we now have a better understanding of why early intervention makes a difference. And taking a neuro-developmental approach in early intervention can decrease the “intensity and severity of the response to trauma

[which] will decrease the probability of developing . . . sensitized neural systems resulting in a persisting hyper-arousal or dissociative symptoms or both” (Perry, Pollard, Blakely, Baker & Vigilante, 1995).

In order to heal a “damaged” or altered brain, interventions must activate those portions of the brain that have been altered (Perry, 2000c). Because brain functioning is altered by repeated experiences that strengthen and sensitize neuronal pathways, interventions can not be constrained to weekly therapy appointments. Interventions must address the totality of the child's life, providing frequent, consistent “replacement” experiences so that the child's brain can begin to incorporate a new environment—one that is safe, predictable and nurturing.

Although early interventions show the most promise for significant recovery from abuse and neglect, later interventions are not futile. However, as children get older, recovery from lost or altered brain functioning may be slower and less complete than recovery attempted earlier in the children's lives (Shore, 1997). But some recovery is certainly possible; while a negative environment may contribute to deficits, a positive environment can contribute to growth (Teicher, 2000).

Prevention

While early intervention with maltreated children can minimize the effects of abuse and neglect, it is equally or even more important to prevent problems before they start. “Clearly, . . . the costs (in human suffering, loss of potential, and real money) of trying to repair, remediate, or heal these children is far greater than the costs of preventing these problems by promoting healthy development of the brain during the first few years

of life” (Ounce of Prevention Fund, 1996, p. 3).

Prevention efforts can target the general population (“primary” or “universal” prevention), educating the public and changing policies to promote healthy brain development. For example, one prevention strategy might involve expanding education efforts that target women who may become pregnant about the effects of alcohol on the developing brain of the fetus. An example of a policy change might involve expanding family leave to allow more parents time off from work to care for and build an attachment to a newborn or adopted child.

Prevention efforts also can target children and families considered to be “at-risk” of developing problems before problems develop (“secondary” or “selected” prevention). By the time a child who has been abused or neglected comes to the attention of professionals, it is likely that some damage already has been done. Secondary prevention efforts must reach out to at-risk families before this point. There are many home visitation programs that provide services to at-risk families before and after the birth of a child—services that support children's healthy development—that have proven to be successful in preventing future problems (Ounce of Prevention Fund, 1996, citing MacMillan, 1994).

Many researchers examining the effects of maltreatment on early brain development agree that this knowledge should be used to expand and strengthen prevention efforts (Ounce of Prevention Fund, 1996; Perry, 1996; Shonkoff & Phillips, 2000; Teicher, 2000). Without expanded prevention, our society will continue to fight an uphill battle to “repair” the damage that has been done to thousands of children who have been abused and neglected. Society can not

continue to ignore the laws of biology (Perry, 1996); the more we learn about early brain development, the more responsibility we have to act on that knowledge.

SUMMARY AND RESEARCH RECOMMENDATIONS

In 1999, approximately 826,000 children were determined to be victims of abuse and/or neglect (U.S. Department of Health and Human Services, 2001), but it is likely that many more children are actually suffering under adverse conditions. Each one of these children already may have suffered damage to their growing brains. Their brains may be locked into perceiving the world as a cold or dangerous place. They may have great difficulties responding to the caring concern of others. Because their brains' energies have been focused on survival, on meeting their own needs, these children may not have developed the physical, cognitive, social, and emotional capabilities one would expect of them. But their future, and the futures of countless others to come, need not be so bleak.

One lesson we have learned from the research on brain development is that environment has a powerful influence on development. Stable, nurturing caregivers and knowledgeable, supportive professionals can have a significant impact on these children's development. And using this growing body of knowledge in prevention efforts can potentially reduce the number of children who will require “reparative” work. There is still much to learn, however. Some of the recommendations from the National Academy of Sciences, Committee on Integrating the Science of Early Childhood Development include:

- Bring together biological and psychosocial researchers to bridge the divide between these fields.
- Understand more about the contribution of genetics to the development process that may explain susceptibility to risk and capacity for resilience.
- Understand more about how biological processes interact with the environment to affect behavior.
- Fund collaborative research projects to study the effect of environment on brain development to learn more about what are deprived, sufficient, and enriched environments.
- Direct program-based research and evaluation to document and test interventions to ensure full effectiveness, and use knowledge from ineffective programs to spur more experimentation (Shonkoff & Phillips, 2000).

While we continue to study and learn more about the effects of maltreatment on early brain development, we can begin to use the knowledge that is already available. We can use this knowledge to strengthen our prevention and intervention strategies, our support of caregivers, and our commitment to provide all children with the nurturance and stimulation they need to grow up healthy and happy.

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